CRAGIST NEWSLETTER January 8th, 1989.

CRAGIST
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CRAGIST (Cedar Rapids And Greater Iowa Sinclair Timex) First meeting January 19th, 1986 and starting its fourth year started with 3 attendees at a meeting and worked up to 6 members and now is down to 5. All use the TS 1000 or TS 1500 and Don has in addition to those the PC 8300 and IQ 8300 and the TS 2068.

The January 8th meeting came to order with the arrival of Gary since the other members had notified that they could not attend. Don fired up his TS 1000 and tested the battery back up system with the TS 2040 printer coming to life every two minutes. There was informal discussion of Mike's computer controlled camera system suspended from a kite (short block TS 1000 in Forth) and his Christmass present of a model radio control transmitter and receiver to be used on his camera/kite project. Discussion touched on batteries and home security.

Next meeting second Sunday in February, February 12th, BE THERE, at Don's house at 1:30.

We now turn this over to a member's contribution.

BATTERY BACKUP
by
DONALD S. LAMBERT

On January 8th, 1989 at a CRAGIST meeting I powered up a T/S 1000 and keyed in a program and LLISTed on the T/S 2040 the program and advanced the printer paper a half inch and then pulled the 110 volt ac plug on the power supply for the T/S 1000 and as the LED that indicated the 110 V AC was on fadded away, I keyed in RUN and ENTER and the printer came to life and then for the next three hours and approximately 17 minutes the computer outputed to the T/S 2040 printer approximately every two minutes.

That was my first trial run with the 12 V 2.5 AH gel cell battery carrying the computer fully operational. Now the gel cell battery is being charged. And I am now trying to correlate all the data and my experiences to arrive at the above system.

I am not a guru - I don't hold an Electrical Engineers degree. My electronic education was a radio repair course by correspondence back in 1943 and what little I've learned since by a course in the school of experiences (good and bad) and bits and pieces of information that I have acquired. I am retired from Collins Radio Company (part of Rockwell International) but I was a mechanical and sheet metal inspector - far removed from any electronics inspection. I did have access to the company Disposal Store where I could buy company unwanted items at low prices. So when a friend called to inform me that the Disposal Store had gel cell batteries for sale I went to the store and bought 4 at the price of $5.00 each.

NOTE:Gel cell batteries are not NICAD - this will not work with NICAD batteries. Gell cell batteries sizes are given by voltage and AH (ampere hours). For instance 12 volts which is actually 12/2 = 6 (for a reason I don't understand a lead acid battery including a gel cell is considered a 2 volt cell when actually a fully charged cell is 2.3 volts.) and 6 X 2.3 = 13.8 volts for a fully charged battery, and by capacity which is given in AH which is normally the current rating if used over a twenty hour period or at the rate of 2.5/20 = 125 ma. The 20 hour period is for getting the most out of a gell cell (and liquid lead acid batteries) without damaging the battery. The gel cells are not design to with stand heavy discharge rates or fast charge rates since that could rupture the seals and let the gel electrolytic leak out. All lead acid batteries have one peculiarity and that is when they are discharging one cell is always a trifle weaker that the others and when it reaches a certain voltage in the discharging the cell will suddenly reverse polarity and thus will act as a load so that that cell cancels the voltage of a good cell so that means that if you measured the voltage of that battery under load the voltage might be 9.2 volts (13.8 - (2 X 2.3) = 9.2)

The charge rate of a lead acid battery should be 1/20 of the AH rating till it reaches 12 V when you can double the charge rate. 2.5 X 1/20 = 125ma (.125 A) and that doubled is 250 ma. I emergency charged the gel cells batteries with a 12 volt car battery charger by limiting the current, in my case I used an 18 ohm resistor (actually two 36 ohm resistors in parallel) to limit the current to 125 ma, be sure the resistors have a high enough wattage rating. How did I know to use an 18 ohm resistor? I checked by using a Heathkit Decade Resistance box which I had purchased long ago at the Collins' Disposal Store. Or you could temporarily use a potentiometer and set it for correct current draw in the circuit and take it out of the circuit and measure the resistance.

The main differences between a battery charger and a power supply for a computer is that the battery charger has a rectifier with a higher current rating and it does not have any filter capacitors. There is one other difference and that is that most power supplies have a pair of capacitors with a resistor betweeen the positive terminals - that resistor will reduce the current output if a power supply is used for a battery charger. In fact, you can not even get 125 ma charge current with a resistor in the circuit. You can tie the two positive terminals of the capacitors together or use one large capacitor. Either will work and I used both.

Since I had bad experiences using one transformer for the project I decided to use 2 12.6 volt transformers, besides I had them - and they are easily available to anyone that wants to build the battery back up power supply. I used heat shrink tubing on all the transformer terminals after soldering to insulate them. Upon powering up I found that the 7805 on the power supply to the computer did run hot, I made no more tests and pulled that part of the citcuitry out and found the screw that held the 7805 to the heat sink loose and also that there was no heat sink grease between the two. (The 7805 and heat sink had been removed from circuitry from the Disposal Store and I

bare computer **********380 ma
with 16K TS 1016 ram pak **********610 ma
with 64K Memopak **********560 ma

Trial run with 16K ram pak using battery only:

TIME		VOLTS
2:32:27	Start**********	12.75
3:32:15	**********	12.00
4:02:07	**********	11.75
5:01:59	**********	11.40
5:31:58	**********	11.00
6:01:	computer shut down **********	7.90

Estimated run time 3 hours 17 minutes, note battery not fully charged - 13.8 volts theoretical full charge.

Using a Heathkit resistance decade box I arrived at these values and charge rates for the power supply. I had used the same current limiting resistors from a prior attempt to use an 18 volt ac transformer and from that I know that values are important, for instance 100 ohms will not charge above 12 volts and 40 ohms will not charge much above 12.75 volts. Here are the values:

Milliamps of charge current		Value of current limiting resistor
100	**********	50
125	**********	37
150	**********	30
175	**********	24
200	**********	20
225	**********	17
250	**********	14
275	**********	12.5
300	**********	11

FORMULAE:

LED current limiting resistor (RS)
RS=(Supply voltage - LED voltage)/LED current (in amperes)

Resistors in parallel (RT)
RT=(R1 X R2)/(R1 + R2).

References:
Engineer's Notebook II by Forrest M. Mims III Radio Shack.
Getting Started In Electronics by Forrest M. Mims III Radio Shack
Semiconductor Reference Guide Radio Shack
Making Fixed-Output Regulators Adjustable by Robert Grossblatt Radio-Electronics June 1983.
Universal Battery Charger by Michael R. Wright Radio-Electronics July 1986.

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with a SASE for answers to questions.

Coming soon an article on cassette tape respooling for program length tapes.

air from the slots, the portion of the case directly above the regulators feel warm to the touch after a while. The regulators in the worst case have to drop about 7 volts at .6 amperes or 4.2 watts of heat- just a word to the importance of a good heat sink or a bigger one if you can find one or make one.

I did use a terminal board held in place with double adhesive foam tape with machine screws for terminals and that made life easier when I had to remove circuitry to change it. I did fuse the transformers but I did not put on a power on/off switch since it will be plugged into a power controller that includes MOVs and EMF protection and also a relay to drop off the line if the power goes down so a return surge will not zap the computer.

Wire up the circuits as given on the circuit diagram page. The two LED's L1 & L2 are connected to ground or the negative supply. All negative or grounds are connected together. If you use different LEDs the current limiting resistors will have to be changed. See the formulae to see how to figure the value. Diodes D1 and D2 with the 8 VDC and 9 VDC are connected together and connected to SW2 circuit lower left. The reason that I used battery binding post was that I had no room to inclose the battery. To set both pots I connected the meter's positive lead to SW2 terminals with the computer turned on and set the voltage to 8 volts and then plugged in the unit and adjusted the pot on the power supply to set the voltage to 9 volts. Test by pulling the plug on the unit and plugging it back in again. The computer will retain its memory so long as the battery is charged.

This is the parts list with those items on the front panel listed by FP1 as an example which would mean front panel location 1 and following that what it was for:
T1 & T2 12.6 volt ac 1.2 A transformer 273-1352
B1 & B2 4A 50 piv bridge rectifier 276-1146
IC1 & IC2 5V 1A 7805 regulator 276-1770 Heat sink 276-1363
L1 FP4 charge on indicator & L2 FP8 110V power on indicator & L3 FP1 computer on indicator 3V 50MA LED 276-026 Holder 276-080
C1 & C5 2200UF 35WVDC Electrolytic capacitor 272-1020
C2 & C6 2.2UF 35WVDC Tantalum capacitor 272-1435
C3 & C7 22UF 35WVDC Electolytic capacitor 272-1014 or 272-1026
C4 & C8 1UF 35WVDC Tantalum capacitor 272-1434
POT1 & POT2 Miniature P. C. POT 1K 271-333
D1 & D2 1N4001 1A 50PIV diode 276-1101
R1 & R2 & R9 & R10 & R11 1/4 watt resistor 270 ohm 271-1314
R3 & R4 & R7 & R8 Wirewound resistor 10 watt 10 ohm 271-132
R5 & R6 Wirewound resistor 10 watt 50 ohm 271-133
SW1 FP6 Charge on/off switch DPDT switch 275-626
SW2 FP5 Computer on/off switch SPST switch 275-624
SW3 FP11 Charge high/low switch SPDT switch 275-625
J1 FP2 red binding post for battery positive lead & J2 FP3 black binding post for battery negative lead & J3 FP9 red binding post for voltmeter postive lead & J4 FP10 black binding post for voltmeter negative lead Multipurpose binding posts set of 4 274-661
SOK1 FP7 jack for power supply to computer lead two conductor 1/8 mini jack open circuit 274-251

Current draw of TS1000 computer:

had not checked it for those things.) I put on a bigger heat sink with heat sink grease and made sure the screw and nut were tight.

Powered up - it gets warm - but not hot. And heating gave no problems on a test run. Time to test the battery for longevity. Testing means writing a program - hey! I can't program! But wait - there's a loop program - where's my notebook? Now to use the T/S 2040 printer to output a number every minute. I wrote this little program, it isn't acurate -close- but I can calibrate the timing later to figure out the exact timing. Here is the program:

```
 5 LPRINT "-TIMING CYCLE 1 MINUTE-"
10 LPRINT "-WITH THE T/S 1000 16K RAM-"
20 LPRINT
30 FOR X=1 TO 600
40 LPRINT X,
50 PAUSE 3515
60 NEXT X
```

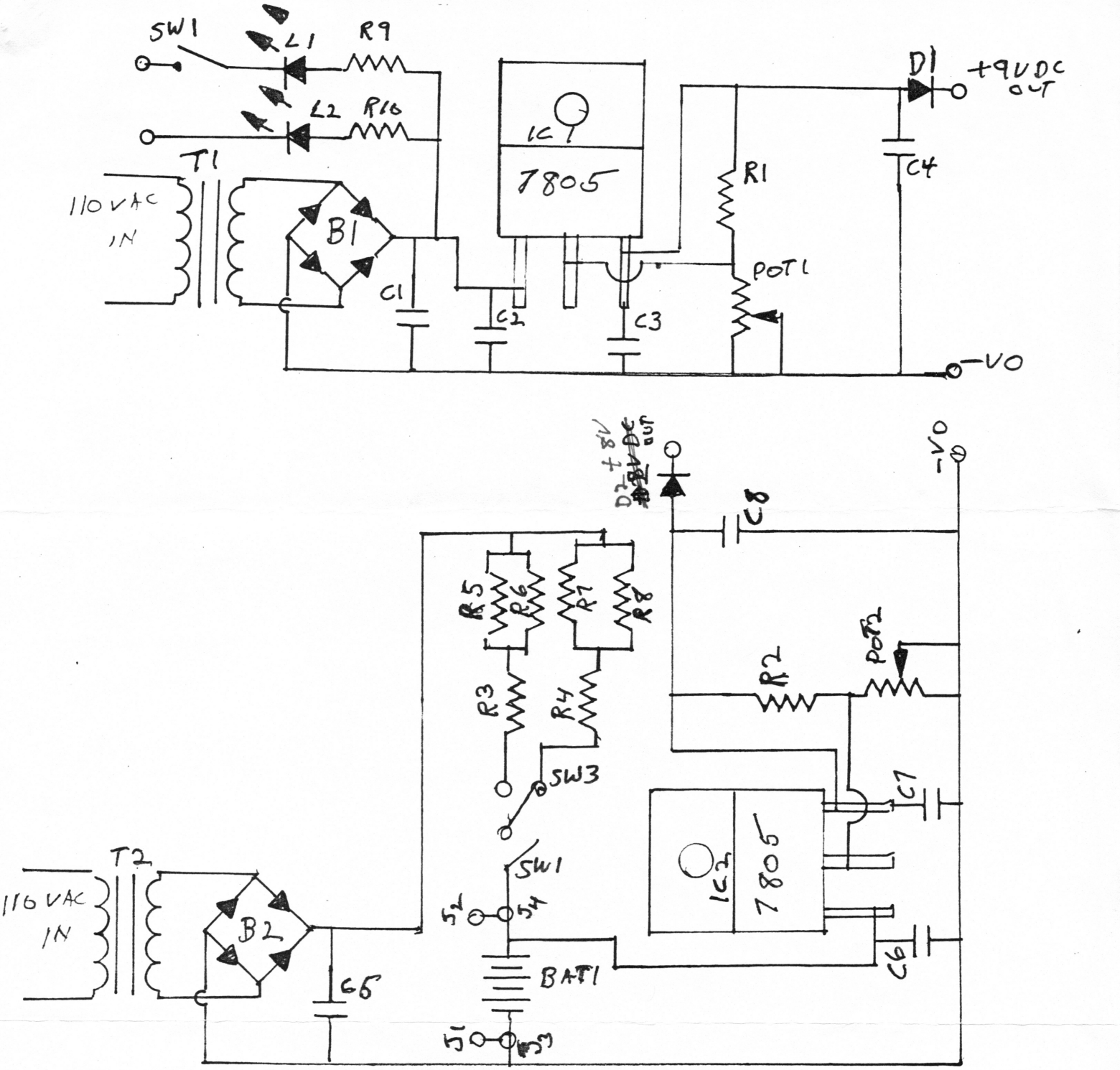
The program works but it waits two minutes (approximately) between print out. The printer may wait for the line to finish before printing.

The thing that makes the change over from power supply to battery and back again are called steering diodes. Not only will a diode only let current flow in one direction but if the diode has a greater positive voltage applied to its positive terminal no current will flow. If there are two or more different circuits are connected through steering diodes the diode with the highest voltage will conduct and the others will act like an open switch - so if the power supply has the highest voltage it will power the computer and then when the power supply fails the steering diode on the battery circuit will start to conduct with too short of an interval between non conducting to conducting for the computer to loose memory.

Before starting construction - remember that the metal tab (with the mounting hole) on the 7805 regulator is also a ground lead and if that is fastened to a heat sink that is at a negative or ground potential then the 7805 regulator will not adjust but will put out 5 volts positive only. The 7805 regulator has to have 2 volts differential between input and output so the lowest you can set battery supply is 7 volts (allowing for the 7805 on the computer board)- I chose 8 volts to have a little leeway and you have to have enough to power whatever is plugged into the expansion port of the computer. I set the ac power supply to 9 volts. I set the voltages while the regulators were under load.

You will need a voltmeter to set the two adjustable regulators and also to monitor the battery for charge. Remember that the only way you can check the battery for charge is to check it under load. Radio Shack has a meter to be mounted that has a full scale reading of 15 volts which could be used and also they have a multimeter for about $20.00 that can also be used to check the charge rate. Or you might have a meter that can be used.

The case the two 7805 regulator circuits go in must have ventilation- mine has slots and while you can't feel any hot



FRONT PANEL NOT TO SCALE